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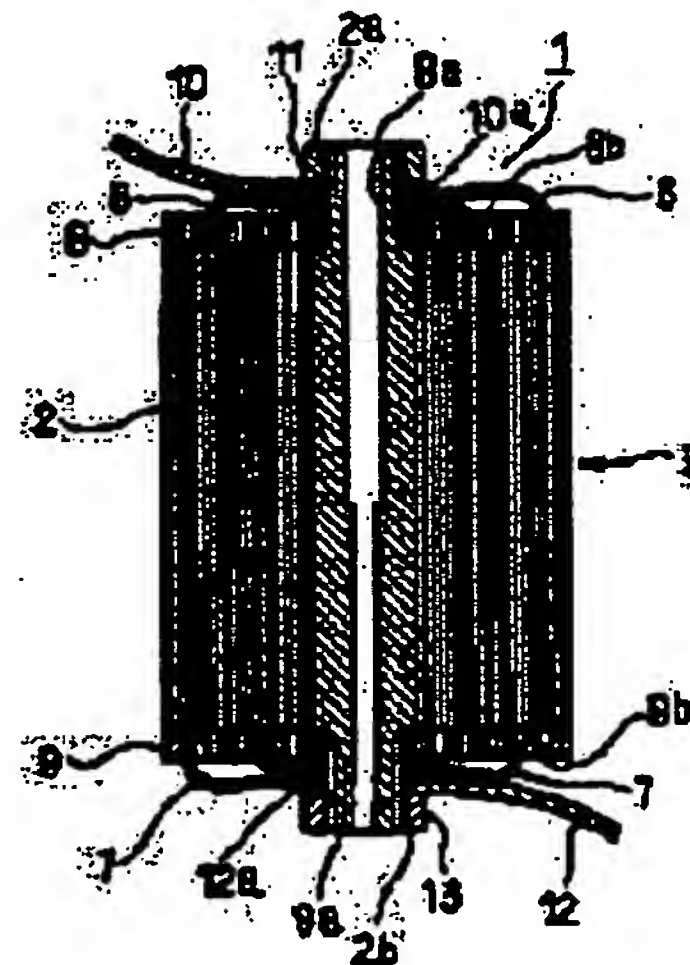
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(54) BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a battery with structure of a number of leads in which a plurality of collecting lead parts are easily connected to an electric conduction member.

SOLUTION: A spiral electrode 3 is formed by piling up a belt-like positive electrode plate to which a positive electrode active material adheres, a separator, a belt-like negative electrode plate to which a negative electrode active material adheres and a separator and spirally winding it around a core rod 2 made of an insulating material. A plurality of collecting lead parts 6 projecting on the upper side are integrally provided in the positive electrode plate, and a plurality of collecting lead parts 7 projecting on the lower side are similarly provided in the negative electrode plate. An insulating plate 8 is provided in the upper end surface of the spiral electrode 3, and the round hole of the tip of the collecting lead parts 6 led out through a slit is fitted into the upper end of the core rod 2. An electric conduction member 10 is fitted into and fixed to the upper end part of the core rod 2 by fastening a nut member 11. Also, on the lower end surface side of the spiral electrode 3, an insulating plate 9 is provided, and similarly the collecting lead parts 7 are fixed and connected.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a cell equipped with the spiral-like electrode which wound the band-like electrode plate so that the shape of a cylinder might be made through a separator.

[0002]

[Problem(s) to be Solved by the Invention] In recent years, the needs of large-capacity-izing of the cell used as the power source and the formation of a high energy consistency have been increasing quickly with the spread of portable electrical machinery and apparatus, such as a cellular phone, and a pocket video camera, a notebook computer. The success or failure of the formation of a high energy consistency in a cell have started how the configuration which can take a large plate area, and structure are acquired in the limited volume, and the so-called rolling-up mold structure with a spiral-like electrode is adopted as many cells as the example of representation.

[0003] The spiral-like electrode of the cell of this kind of rolling-up mold is manufactured by applying the forward and negative active material which generates a current, manufacturing a forward and negative electrode plate, respectively, piling them up through a separator, and winding around the front face of a band-like metallic thin plate with high conductivity, such as copper called a charge collector and aluminum, (or foil) in the shape of a spiral by the cell reaction. On the other hand, in order [that] to attain large capacity-ization in the cell of this kind of rolling-up mold, the a large number book lead structure which derived the lead from the multipoint of the longitudinal direction of each electrode plate for the purpose of large-capacity-izing of a current path and the reduction in resistance so that a heavy load and a high current could be borne is considered. In this case, each lead is packed into one inside a cell, and is connected to the electrode terminal of the container exterior through a conductive member.

[0004] However, with the above-mentioned a large number book lead structure, the lead of two or more had to be packed in the narrow space where the interior of a cell was restricted, it had to connect with the conductive member, and the activity also had a possibility that an antipole might be contacted according to the sag of a lead etc., and an internal short circuit might occur with remarkable difficulty.

[0005] Then, as an approach of solving the trouble, the junction plate made from nickel is formed in the end face of a spiral-like electrode through an electric insulating plate, and the technique which welds the lead of two or more drawn through the circular slit formed in the electric insulating plate and the junction plate to the top face of the junction plate is shown in JP,57-1402,Y. According to this, a possibility that each lead can be easily welded to a junction plate, and an internal short circuit may occur with an electric insulating plate is also lost. However, with this technique, in order to weld near the end face of a spiral-like electrode, the electric insulating plate melted with the heat in that case, and there was nonconformity which that heat is transmitted [nonconformity] in a lead and damages a separator.

[0006] in addition -- damaging a separator in the welded section, since thickness becomes an ununiformity although said lead is generally formed in an electrode plate (charge collector) by welding **** -- a part -- a current -- concentrating -- an abnormality deposit of an active material -- happening -- simplistic -- there was also a possibility of resulting. Especially in the thing which used the lithium

metal for the negative electrode, a needlelike sludge called a dendrite arose by current concentration, and there was also a situation from which this causes cycle degradation and an internal short circuit. [0007] This invention was made in view of the above-mentioned situation, and the object is equipped with the so-called a large number book lead structure, and is to offer the cell which makes it possible to connect easily two or more current collection lead sections to the conductive member for external connection, without using welding.

[0008]

[Means for Solving the Problem] The cell of claim 1 of this invention is equipped with the spiral-like electrode which wound the band-like electrode plate which put the forward or negative active material on the front face so that the shape of a cylinder might be made through a separator. While preparing intermittently two or more current collection lead sections which project in the shaft orientations of said spiral-like electrode from the edge section which is one of those it was made to collect a current from the multipoint of the spiral-like electrode, and is prolonged to said band-like electrode plate at the longitudinal direction On the mandril which has the insulation arranged at the core of said spiral-like electrode, it has the description at said configuration which fixes two or more current collection lead sections of a book to a stop condition, and was connected to the conductive member for external connection in the axial part.

[0009] In this case, it is effective if the insulating plate which has the slit by which the current collection lead section is inserted in the end-face part of a spiral-like electrode is prepared in the penetration condition of a mandril (invention of claim 2). Plurality may be formed in the shape of radii (invention of claim 3), or you may make it form the slit of an insulating plate in the shape of a spiral at this time (invention of claim 4).

[0010] And it is more effective, if the current collection lead section can be formed in an electrode plate at one (invention of claim 5), and the part which stands in a row in the current collection lead section from an electrode plate is constituted at this time so that the shape of a curve may be made (invention of claim 6). Furthermore, the wire extension dimension of the current collection lead section can also be constituted so greatly [it is so small that it is located in the winding core side of a spiral-like electrode, and] that it is located in a winding periphery side (invention of claim 7).

[0011]

[Embodiment of the Invention] Hereafter, one example of this invention is explained, referring to drawing 1 thru/or drawing 4 . Drawing 1 shows the internal configuration of the cell 1 concerning this example. Here, in the case which is not illustrated where the shape of a cylinder is made, as shown also in drawing 2 , around the mandril 2, this cell 1 has the spiral-like electrode (rolling-up electrode) 3 wound in the shape of a cylinder, and is constituted. Moreover, although this does not carry out a graphic display, either, the forward and negative electrode terminal is prepared in said case.

[0012] From insulating materials, such as plastics, such as polypropylene, and ceramics, said mandril 2 is constituted in the shape of [in the air] the round bar, and is formed in die length to which vertical both ends project from said spiral-like electrode 3. Moreover, let the vertical both ends of this mandril 2 be male screw section 2a in which the male screw was formed, and 2b while they are formed in mist or small diameter from the part which winds the spiral-like electrode 3, respectively.

[0013] Said spiral-like electrode 3 winds the positive-electrode electrode plate 4 (refer to drawing 3), a separator, a negative-electrode electrode plate, and a separator (after 3 person is not shown) around the perimeter of superposition and said mandril 2 in the shape of a spiral, and is constituted. Among these, as shown in drawing 3 , the positive-electrode electrode plate 4 puts positive active material 5 (drawing 3 attaches and shows a slash for convenience) by spreading, sticking by pressure, etc., and is constituted by the front face of the metallic thin plate (charge collector) which makes band-like.

[0014] In this case, as a metallic thin plate (charge collector), the thing of the conductive high construction material of aluminum, copper, etc. is used, for example, and a lithium manganic acid ghost and lithium cobalt oxide are used as said positive active material 5, for example. Furthermore, in this case, several micrometers - about dozens of micrometers and a width method are set to several cm - about dozens of cm, and the linear dimension is made into about 1-10m for the thickness dimension of

said metallic thin plate.

[0015] And as shown in this positive-electrode electrode plate 4 also at drawing 2, two or more current collection lead sections 6 are formed in this field alloy sheet metal at one. these current collection lead section 6 -- drawing of the positive-electrode electrode plate 4 -- the upper part from rising wood -- projecting -- making -- the die-length direction of the positive-electrode electrode plate 4 -- being intermittent (for example, regular intervals) -- it is formed and a little large path is more nearly circular than the outer diameter of male screw section 2a of said mandril 2 to a part for the point -- hole 6a is formed.

[0016] Moreover, these current collection lead section 6 is formed so that it may become long, as the wire extension dimension is so short that it is located in the winding core side (it is left-hand side at drawing 3) of the spiral-like electrode 2 and goes to a winding periphery side (it is right-hand side at drawing 3). Furthermore, in this example, interior angle partial 6b of the root which stands in a row in the current collection lead section 6 from the positive-electrode electrode plate 5 is not right-angled, and it is formed so that it may continue in the shape of a curve (the shape of R). In addition, a pitch, a number, etc. of this current collection lead section 6 are set up based on the overall length of the electrode plate 4, the target cell engine performance, etc.

[0017] On the other hand, said negative-electrode electrode plate puts a negative-electrode active material on the front face of the metallic thin plate (charge collector) which makes band-like [of aluminum copper, etc.] too, and is constituted. In this case, as a negative-electrode active material, it consists of a metal lithium, its alloy, or matter (carbon and graphite) that can carry out occlusion of the lithium ion. Moreover, the dimension of a metallic thin plate is made equivalent to the above-mentioned positive-electrode electrode plate 5.

[0018] And two or more current collection lead sections 7 (it illustrates only to drawing 1) are formed also in this negative-electrode electrode plate at one. Although these current collection lead section 7 is intermittently formed so that it may project caudad from the margo-inferior section in drawing of a negative-electrode electrode plate, and a graphic display is not carried out in detail, the circular hole of a little larger path than the outer diameter of male screw section 2b of said mandril 2 is formed in a part for a point like the above-mentioned positive-electrode electrode plate 5. Moreover, the wire extension dimension of these current collection lead section 7 is formed so that it may become long, as it goes to a winding periphery side so short that it is located in the winding core side of the spiral-like electrode 2, and the interior angle part of the root which stands in a row in the current collection lead section 7 from a negative-electrode electrode plate is further made into the shape of a curve.

[0019] In addition, while said separator of two sheets consists of construction material which both has the micropore which can pass ion including the electrolytic solutions, such as PP and a nonwoven fabric, and the thickness dimension is set to dozens of micrometers, a width method is longer than the width method of said positive-electrode electrode plate 5 (metallic thin plate) several mm, and the linear dimension is formed for a long time several cm - dozens of cm rather than the linear dimension of said positive-electrode electrode plate 5.

[0020] If it is in the spiral-like electrode 3 which piled up and wound the positive-electrode electrode plate 4, the separator, the negative-electrode electrode plate, and the separator now, as shown in drawing 2 (a), it considers as the gestalt in which two or more current collection lead sections 6 projected from the upper bed surface part, and two or more current collection lead sections 7 come to project from a soffit surface part.

[0021] Now, the insulating plates 8 and 9 are formed in the vertical ends surface part of the spiral-like electrode 3 constituted in this way, respectively. Drawing 4 is made to represent the insulating plate 8, it is shown in it, and these insulation plates 8 and 9 are constituted from insulating materials, such as plastics, such as polypropylene, and ceramics, by the thin disc-like one of a path almost equivalent to the spiral-like electrode 3. Moreover, while the feed holes 8a and 9a which are located at the core and said mandril 2 penetrates are formed in the plate surface, two or more circular slits 8b and 9b are mostly formed in the perimeter concentric circular.

[0022] As shown in drawing 2 (a), the insulating plate 8 is formed so that the upper bed surface part of

the spiral-like electrode 3 may be covered. At this time, the upper bed section (male screw section 2a) of a mandril 2 penetrates feed-hole 8a of the insulating plate 8, and it is located in the top-face section of the insulating plate 8, and two or more current collection lead sections 6 are inserted in circular slit 8b, and are located in the top-face section of the insulating plate 8.

[0023] And two or more current collection lead sections 6 located in the top-face section of the insulating plate 8 are summarized in the condition of having considered as the condition of having been stopped by the mandril 2 and having lapped with one place, by making round shape hole 6a at the head fit in male screw section 2a of a mandril 2, as shown in drawing 2 (b). In addition, it is fitted in male screw section 2a sequentially from the current collection lead section 6 located in an inner circumference side in this case.

[0024] Furthermore, from this condition, after terminal area 10a of the conductive member 10 for external connection is fitted in male screw section 2a of said mandril 2, the nut member 11 is bound tight by male screw section 2a. Now, so to speak, the upper bed section of a mandril 2 achieves the function as a terminal, and two or more current collection lead sections 6 and a conductive member 10 are fixed to the upper bed section of a mandril 2 in the state of electrical installation. In addition, the other end side of a conductive member 10 is connected to the forward electrode terminal of a cell 1.

[0025] On the other hand, as shown in drawing 1, it also sets to the soffit side side of the spiral-like electrode 3. It is prepared so that similarly the soffit section of a mandril 2 may penetrate [the insulating plate 9] feed-hole 9a and two or more current collection lead sections 7 may be inserted in slit 9b. Two or more current collection lead sections 7 are fitted in male screw section 2b of a mandril 2, and it considers as a stop condition, and further, after the conductive member 12 has piled up, bolting of a nut 13 is fixed. Said conductive member 12 is connected to the negative electrode terminal of a cell 1.

[0026] In the cell 1 constituted as mentioned above, by having the spiral-like electrode 3, area of an electrode plate can be extremely enlarged in the limited volume, and large-capacity-izing and high energy consistency-ization can be attained, and large-capacity-izing of a current path and low resistance-ization can be attained by having drawn the current collection lead sections 6 and 7 from the multipoint at this time.

[0027] And in this example, since the mandril 2 which has insulation is formed in the core of the spiral-like electrode 3 and the current collection lead sections 6 and 7 were fixed to the stop condition at the edge of the mandril 2, so to speak, a mandril 2 can play a role of a terminal, and can connect easily two or more current collection lead sections 6 and 7 to conductive members 10 and 12. In this case, since the welding itself becomes unnecessary unlike what welds the lead of two or more to a metal junction plate like before, it can prevent beforehand having an adverse effect on an insulating material (the insulating plates 8 and 9 and separator) with the heat in that case.

[0028] Moreover, since it constituted so that the insulating plates 8 and 9 might be formed in the end-face section of the spiral-like electrode 3 and the current collection lead sections 6 and 7 might be connected to it by the outside surface side, it can prevent beforehand that the end face and the current collection lead sections 6 and 7 of the spiral-like electrode 3 are isolated with the insulating plates 8 and 9, the current collection lead sections 6 and 7 contact an antipole in an end face, and an internal short circuit occurs.

[0029] In this case, since many circular slits 8b and 9b were formed in the insulating plates 8 and 9, the current collection lead sections 6 and 7 can be made to be able to draw outside on them through the slits 8b and 9b of the arbitration corresponding to that location, and that activity can be easily done on them. Furthermore, since the insulating plates 8 and 9 have regulated the deflection of the current collection lead sections 6 and 7, it is the thing in the root part of the current collection lead sections 6 and 7 which can bend, as a result can prevent breakage etc.

[0030] Furthermore, since the current collection lead sections 6 and 7 were especially formed in the electrode plate (charge collector) by this example at one, it is lost that an ununiformity arises in the thickness of an electrode plate like [in the case of forming the lead of another object in an electrode plate by welding], and the breakage on a separator and the abnormality deposit of an active material resulting from the ununiformity of thickness can be prevented beforehand. Since interior angle partial 6b

of the root which stands in a row in the current collection lead section 6 from the electrode plate 5 was formed in the shape of a curve at this time, a possibility that a crack may occur in that part like [in the case of having the right-angled corner, for example] is lost.

[0031] And since the wire extension dimension of the current collection lead sections 6 and 7 was constituted from this example so greatly [it is so small that it is located in the winding core side of the spiral-like electrode 3, and] that it is located in a winding periphery side The wire extension of each current collection lead sections 6 and 7 should be corresponded to the distance to a mandril 2, the sag condition to the mandril 2 of each current collection lead sections 6 and 7 can be equalized, and immobilization to a mandril 2 can be performed now still more easily.

[0032] Thus, the outstanding practical effectiveness that large-capacity-izing of a current path and the reduction in resistance in the volume which is equipped with the so-called a large number book lead structure, and became possible [connecting easily two or more current collection lead sections 6 and 7 to the conductive members 10 and 12 for external connection, without using welding], as a result was restricted can be attained according to this example can be acquired.

[0033] In addition, although form round shape hole 6a in the point of the current collection lead section 6, this is made to fit in a mandril 2 and it was made to consider as the stop condition in the above-mentioned example As shown in the electrode plate 17 of other examples of this invention shown in drawing 5, the part is inserted in a mandril 2 from a periphery side, and it may be made to consider by forming U character-like infeed section 18a in the point of the current collection lead section 18 as a stop condition.

[0034] Moreover, drawing 6 shows the insulating plate 21 concerning other examples from which this invention differs. This insulating plate 21 is too constituted from an insulating material by disc-like, is located only in the part (part by which the current collection lead section is drawn from the end-face section of the wound spiral-like electrode) in which the current collection lead section is inserted, and forms slit 21a beforehand. Moreover, drawing 7 shows the insulating plate 22 concerning other further different examples, and it forms slit 22a in the shape of a spiral, and he is trying to derive the current collection lead section from the location of the arbitration here.

[0035] In addition, this invention is not limited to each above-mentioned example, and the following escapes and modification are possible for it. That is, various kinds of means, such as performing the Rika bundle which used the E ring for the connection (fixed means) besides the nut, although the current collection lead section and a conductive member were connected by binding a nut member tight in the male screw section of a mandril in the above-mentioned example, are idea **. Unless it has an adverse effect by heat at this time, welding, soldering (soldering), etc. may be used.

[0036] Moreover, the current collection lead section of what [not only] forms the current collection lead section in one but another object may be welded to an electrode plate, or you may not solder, and if it is the case where the problem of the ununiformity of thickness is not thought so much as important, it will become easy [a fabrication of an electrode plate] comparatively [the direction of the approach of welding the current collection lead section of an exception object rather]. Furthermore, it can carry out by changing variously about construction material, dimensions, etc., such as an electrode plate (charge collector), and a forward and negative active material, a separator.

[0037]

[Effect of the Invention] According to the cell of claim 1 of this invention, it is fixed to the mandril which is arranged at the core of a spiral-like electrode and plays a role of a terminal so to speak, and two or more current collection lead sections drawn by shaft orientations in the end-face section of a spiral-like electrode are connected to a conductive member. Therefore, the outstanding practical effectiveness that large-capacity-izing of a current path and the reduction in resistance in the volume which is equipped with the so-called a large number book lead structure, and became possible [connecting easily two or more current collection lead sections to the conductive member for external connection, without using welding], as a result was restricted can be attained can be acquired.

[0038] In this case, if the insulating plate which has the slit by which the current collection lead section is inserted in the end-face part of a spiral-like electrode is prepared in the penetration condition of a

mandril (cell of claim 2), since a part for the head flank of the current collection lead section and the end face of a spiral-like electrode will be isolated with an insulating plate, it can prevent beforehand that contact an antipole and an internal short circuit occurs. Plurality may be formed in the shape of radii (cell of claim 3), or you may make it form the slit of an insulating plate in the shape of a spiral (cell of claim 4), and all can make the current collection lead section draw easily at this time.

[0039] And if the current collection lead section is formed in an electrode plate at one (cell of claim 5), unlike the case where it welds to an electrode plate by using the current collection lead section as another object, it is lost that the thickness of an electrode plate becomes uneven, and the breakage on a separator and the abnormality deposit of an active material resulting from the ununiformity of thickness can be prevented beforehand. Into the part which stands in a row in the current collection lead section from an electrode plate at this time, if there is a possibility that a crack may occur in that part when it has the right-angled corner, but this part is constituted so that the shape of a curve may be made (cell of claim 6), such crack initiation can be prevented beforehand, for example.

[0040] Furthermore, are so small that the wire extension dimension of the current collection lead section is located in the winding core side of a spiral-like electrode. When constituted so greatly that it is located in a winding periphery side (cell of claim 7), the wire extension of each current collection lead section should be corresponded to the distance to a mandril. The sag condition to the mandril of each current collection lead section can be equalized, and immobilization to a mandril can be performed now still more easily.

[Translation done.]